

Laser Safety with Line Laser Modules

Safety Information · OEM line laser modules and sets

Product name	Laser safety with line laser modules	Spec	5 – 2026
Description	OEM line laser modules and sets	Rev	09/2026
Product line	Line lasers, cross lasers	Status	Information

Overview

Lasers are potentially dangerous — this can be assumed as a starting point. When it strikes a human eye, and in particular the retina, the tightly focused laser light produces a very high energy density, which can damage the visual cells. At higher powers, there may even be a hazard to the skin.

To exclude any hazard to persons, our line and cross lasers can very easily be assigned to a harmless laser class. This is achieved simply by the technical conversion of the laser beam into a line or a cross, which distributes the laser light over a relatively large area. Laser class 2 is therefore reached after very short distances; according to EN 60825-1, OStrV and TROS this class is considered harmless, because the blink reflex of the human eye, present under normal circumstances, ensures that damage can be ruled out.

The distance after which the laser light can be classified as class 2 or class 1, and thus considered harmless, depends on the configuration of the line laser and varies with power and fan angle. The appendix therefore contains a table of the recommended minimum distances.

The difference between „laser“ and „laser installation“

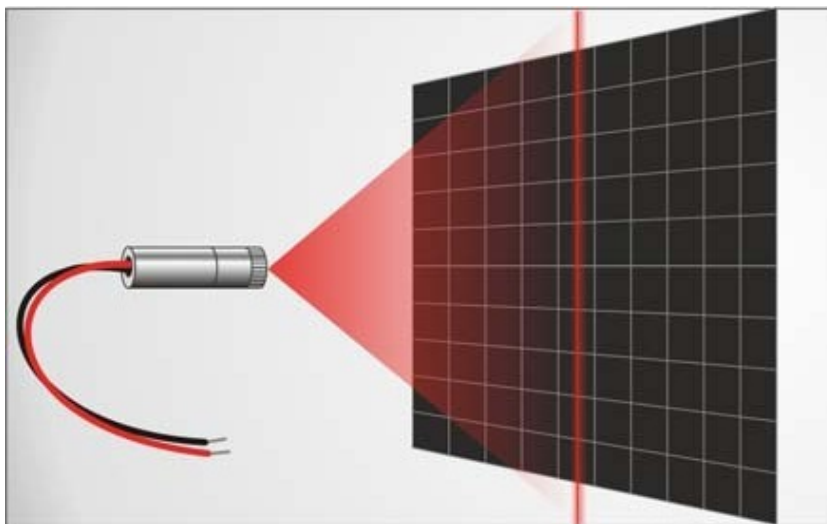
The term „laser“ refers to the laser device or laser module itself. If it is attached to a machine or another installation, a „laser installation“ is created. For the safety classification of an installed line laser it is very important to consider the overall installation. This is referred to as the „laser installation“ and includes all measures and the entire environment in which the laser is used.

The laser device and the laser installation may – and indeed must – have different laser classes. This is normal. For the class assignment according to OStrV it is always the **laser installation**, that is the laser in its installed state, that must be assessed.

Mounting a line laser correctly

To achieve laser safety, a line laser must be mounted accordingly on a machine or fixture. In principle: the operator or user must not be able to look directly into the laser beam at the module. The module must be attached mechanically securely so that it cannot accidentally fall off or come loose and thereby create a hazard.

If it is not possible to mount the laser module sufficiently far away from the user, the operator can also be protected against accidentally looking into the laser beam by means of a lateral cover.



The following applies in principle: the larger the angle, the less dangerous the laser. Because the power is distributed over a larger area, the mounting distance becomes progressively less critical at larger angles.

Safety distances to the operator or user

As already mentioned, a minimum distance from the laser to the operator or user must be maintained after the laser module has been mounted. Within this distance, irradiation of a human eye must not be possible. This also includes accidental

exposure, for example if someone were to rest their head on the working surface and thus look into the beam. Unintentional falls also count here.

As can be seen from the following explanations, these distances are quite generous and uncritical, because with a line laser the power decreases sharply as the distance increases.

According to EN 60825-1, laser sources do not become more dangerous below a distance of 100 mm, even if one approaches the laser source further, because the accommodation of the eye is no longer able to focus the incident figure sharply and therefore no additional load on the retina occurs. In plain terms: if a line laser can be safely classified (in class 1 or 2) at 100 mm, then neither a higher class nor a greater risk arises at a shorter viewing distance. The distances can therefore be determined at 100 mm.

Example: If a line laser is classified as class 2 at a distance of 100 mm or less on the basis of its power and line angle, no further safety measures are necessary for this laser, even if the safety distance of 100 mm cannot be maintained.

See also EN 60825-1

A.4	Measurement conditions
A.4.2	Limiting aperture
D.2.2	Hazards to the eye, section „viewing distance“

Hazard assessment according to OStrV and TROS 2018

The radiation of a line laser is described in the current TROS as an „extended source“, because it is not a fully collimated laser beam but a strongly divergent and expanded laser source. The hazard assessment of an extended source can be evaluated using a test setup with a collimating lens. Here the collimating lens simulates the lens in the human eye. The expanded laser light of the extended source is focused to a retina-relevant size and produces a non-circular image on the retina, which usually appears rectangular. This reduces the hazard compared with regularly collimated laser radiation.

This hazard reduction can be expressed by a correction factor, which is usually between 1.5 and 3. This correction factor is used as a multiplier for the MPE of class

2. If this correction factor is 2, for example, the MPE would be $1 \text{ mW} \times 2 = 2 \text{ mW}$ at an aperture of 7 mm.

Two options are available for assessing the hazard from a line laser:

- Assessment based on the power per aperture (simple, arithmetical method)
- Assessment based on the projected image, reduced by a measured correction factor, or based on a calculated correction factor

The simpler and most commonly used method – the arithmetical hazard assessment based on the power per aperture – can be carried out and calculated at any time because of its simplicity. A possible correction factor is not deducted here. It can therefore be assumed that the arithmetical hazard determination still represents a generous deviation in the safe direction.

Where necessary, or in borderline cases, an assessment using the measurement method and the resulting correction factor must be carried out. For known laser sources, the current TROS already provides ready-made formulas with which the correction factor and the newly determined MPE values can be calculated. For laser class 2, into which we must classify our line laser or the laser installation containing a line laser, there is a maximum permissible laser power according to the TROS calculations, measured at a measuring aperture of 7 mm diameter. For an extended source we apply the calculated correction factor and then determine the necessary minimum line length at the point of incidence. The point of incidence is the point at which a hazard to an observer could occur for the first time.

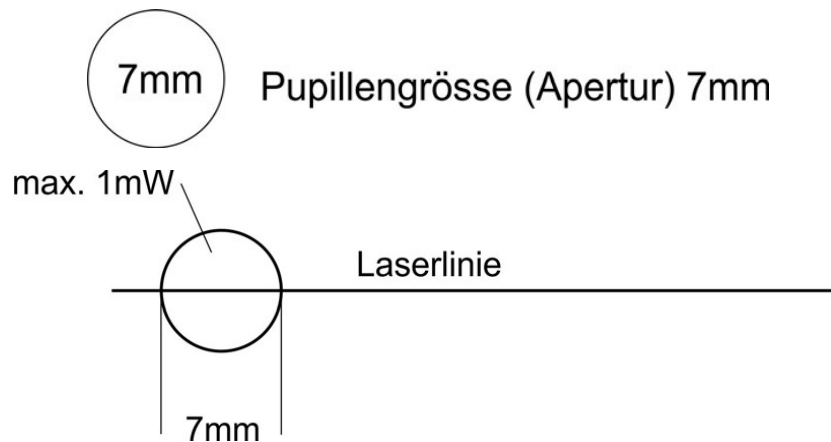
Further notes and implementation proposals for the assessment of line lasers can be found in the current TROS Part 2, section 5.7.

Simple arithmetical determination of the hazard without correction factor

If the permissible correction factor for an „extended laser source“ is disregarded and the standard table for the permissible exposure values of a collimated source is used, an approximate safety calculation can be carried out using the following method.

In principle, the accident prevention regulations for laser class 2 state: the aperture of the pupil (pupil size) is specified as 7 mm. A maximum of 1 mW of power may enter

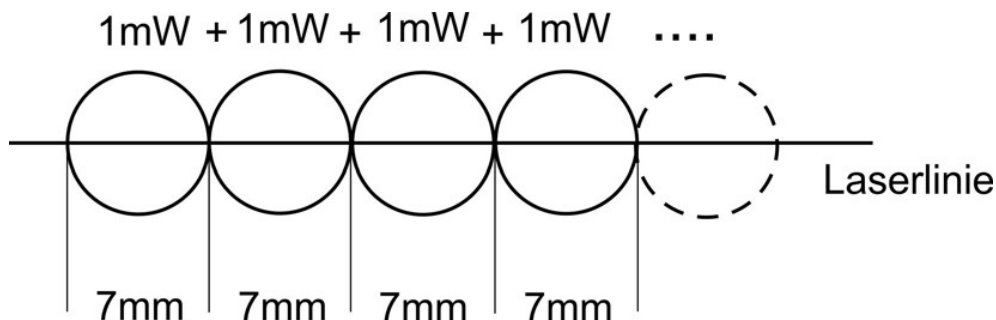
the eye (aperture). A simple pinhole diaphragm can be used as the aperture (measuring diaphragm).



Assuming that a user or operator could look into the laser line at a certain point, the following can be said: the laser line can be divided arithmetically into 7 mm sections, adding 1 mW of laser power per 7 mm. So if there is a laser line 70 mm long at the hazard point, 10 mW of laser power would be permissible here, at 140 mm already 20 mW, and so on.

What matters here is the **line length**, not the distance to the line laser. The line length changes with the fan angle.

Aperture addition method



In this way the hazard can be assessed, and ruled out, very simply.

The line length is therefore calculated from the line angle using the formula line length = $2 \times \tan(\text{angle} / 2) \times \text{distance}$, and the power calculation above is then used to determine the line length required for classification into class 2. From this the safety distance can be derived.

Important: This safety distance must be maintained under all circumstances.
Where necessary it must be ensured by means of a diaphragm, funnel or spacer.

Appendix 1 · Applicable regulations and standards

Lasers are classified and assessed according to the following standards:

Type	Regulation	Source
Standard	VDE 0837 / EN 60825-1	available from the VDE
Occupational safety ordinance	OStrV, 2010 and later	Download
Further information	TROS 2018	Download

Appendix 2 · Marking of the laser area

Every laser installation must be marked with the corresponding warning notice. If a line laser is mounted in accordance with the safety distances stated above, the resulting laser installation falls under class 2M and must therefore be provided with the following markings:



Warning sign laser class 2M

Laser radiation – Do not stare into the beam or view directly with optical instruments. Laser class 2M according to DIN EN 60825-1.



Laser beam warning symbol

Warning sign W004 „Warning of laser beam" for marking the laser area.

We are happy to advise you on the safety implementation or calculation. We also prepare expert reports for your laser installation, including a hazard assessment and laser class classification.

Further information is also available at www.lasershop.com/de/Laserblog/

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Safety data sheet MediaLas laser modules LLM / KLM

Approximate safety distances for MediaLas line lasers and cross lasers

The following tables give an overview of the minimum distances required to comply with laser class 2 for various laser modules. In most cases, a more detailed assessment of the actual installation – that is, the final laser installation – leads to shorter and more tolerant distances. A measurement can additionally be helpful here.

A correction factor for „extended sources" of 1.5 was used as the basis for the distances given below. In most cases this correction factor is in fact in the range up to approx. 3, which means that three times more light may enter the eye than with focused sources. The safety distances can therefore be shortened further.

Whether the lasers are red or green emitting models is irrelevant for classification into laser class 2, because EN 60825-1 treats the entire visible range from 400 – 700 nm with the same MPE values. The tables are therefore based solely on the laser power.

Safety distances for high-power line lasers must be calculated somewhat differently, because the line width is considerably greater than with „regular" line widths. An on-site inspection should always be carried out in these cases.

Line laser overview

Power	20°	35°	45°	60°	90°	110°	120°	120° glass
4 mW	55 mm	35 mm	27 mm	20 mm	12 mm	12 mm	12 mm	12 mm
5 mW	70 mm	45 mm	34 mm	23 mm	15 mm	14 mm	13 mm	15 mm
10 mW	140 mm	78 mm	60 mm	42 mm	25 mm	22 mm	20 mm	25 mm
20 mW	275 mm	150 mm	115 mm	80 mm	46 mm	35 mm	31 mm	46 mm
25 mW	340 mm	190 mm	145 mm	100 mm	58 mm	45 mm	39 mm	58 mm
30 mW	410 mm	225 mm	175 mm	120 mm	70 mm	55 mm	46 mm	70 mm
40 mW	530 mm	300 mm	230 mm	160 mm	93 mm	72 mm	62 mm	93 mm
50 mW	685 mm	375 mm	285 mm	200 mm	115 mm	90 mm	78 mm	115 mm
75 mW	1050 mm	560 mm	380 mm	300 mm	175 mm	135 mm	115 mm	175 mm

Power	20°	35°	45°	60°	90°	110°	120°	120° glass
100 mW	1400 mm	750 mm	575 mm	400 mm	230 mm	180 mm	155 mm	230 mm
300 mW	2800 mm	1500 mm	1225 mm	950 mm	680 mm	540 mm	470 mm	700 mm
500 mW	3500 mm	2200 mm	1850 mm	1500 mm	1100 mm	900 mm	800 mm	1150 mm
700 mW	4200 mm	2800 mm	2300 mm	1800 mm	1300 mm	1070 mm	950 mm	1300 mm
1000 mW	5000 mm	3300 mm	2800 mm	2250 mm	1650 mm	1350 mm	1200 mm	1750 mm

Cross line laser overview

Power	5°	15°	55°
4 mW	110 mm	35 mm	15 mm
5 mW	130 mm	45 mm	18 mm
10 mW	280 mm	78 mm	25 mm
20 mW	550 mm	150 mm	45 mm
25 mW	680 mm	190 mm	55 mm
30 mW	820 mm	225 mm	62 mm
40 mW	1060 mm	300 mm	85 mm
50 mW	1370 mm	375 mm	110 mm
75 mW	2100 mm	560 mm	160 mm
100 mW	2800 mm	750 mm	220 mm

CAUTION! The information in this data sheet is to be regarded as a guideline only. For a more precise classification, a detailed inspection should be carried out on the respective laser installation.